# Genetic Mapping of Rust-Resistance Genes in Sunflower

Rust is a serious fungal disease of sunflowers around the world. The disease can significantly reduce sunflower yields and has been increasing in severity in North America in recent years. In 2013, U.S. farmers produced more than 2 billion pounds of sunflowers, worth over $757 million dollars.

Sunflower seeds are predominantly grown as an oilseed crop, but some varieties are specifically grown as "confection" varieties, meaning their kernels are for eating—either raw or roasted.

An economic and environmentally friendly method to control rust is to use resistant cultivars and hybrids. Developing genetically resistant hybrids is the preferred approach for disease management, but few widely effective resistance sources to sunflower rust have been identified.

Agricultural Research Service molecular geneticist Lili Qi, in the Sunflower and Plant Biology Research Unit in Fargo, North Dakota, has screened for resistance genes and genetic markers in sunflower genomes. Her collaborators in the study, which was published in *Theoretical and Applied Genetics,* included Thomas Gulya and Brent Hulke, in the sunflower research unit, and Li Gong and Samuel Markell, with North Dakota State University.

First, Qi and her colleagues identified DNA markers to determine the possible locations of resistance genes on sunflower chromosome 13. Two resistance genes have been mapped by the group—$R_{13a}$ in the confection sunflower line called "HA-R6" and $R_{13b}$ in the oilseed line called "RHA 397."

The USDA inbred line HA-R6 is one of the few confection sunflower lines resistant to rust.

"The genes $R_{13a}$ and $R_{13b}$ are highly effective against all rust races tested so far," says Qi. "The newly developed markers will help in breeding efforts to confer rust resistance to the sunflower genomes and accelerate the development of rust-resistant sunflower hybrids in both confection and oilseed sunflowers."

These genetic findings couldn't come at a better time. In an annual field survey conducted by the North Dakota State University Cooperative Extension Service and the U.S. National Sunflower Association, sunflower rust was found in 60 to 77 percent of surveyed fields. Kernels infected by rust can be damaged and discolored and are therefore unlikely to meet grading standards established by the industry for confection sunflower seeds.

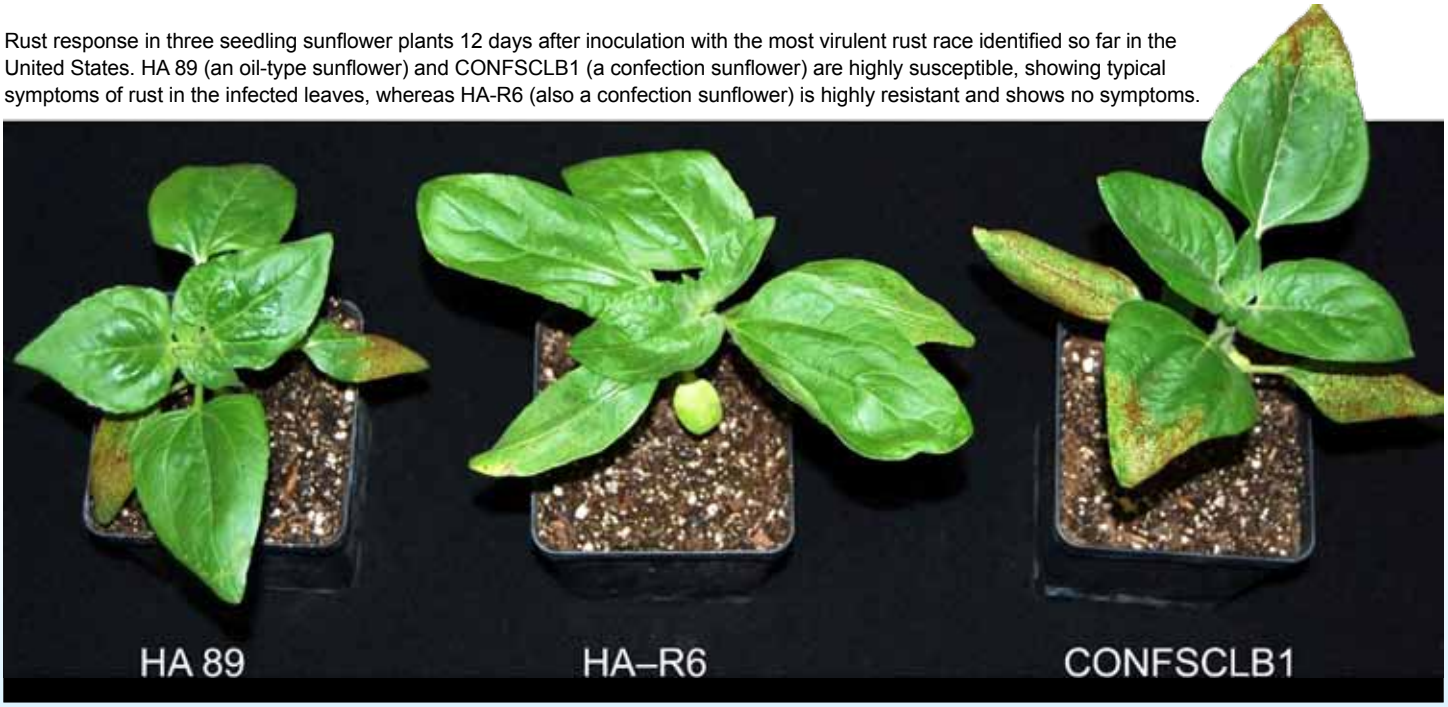
"Yield losses to the disease can occur in the wide range of environments and climatic conditions where sunflowers are grown—from the hot and dry climates of the U.S. Central Great Plains to the cooler and wetter climates of North and South Dakota," says Gulya.

"These lines, HA-R6 and RHA 397, should be very useful in breeding commercial sunflower hybrids with high-level, durable resistance to rust," says Qi.—By **Sharon Durham,** ARS.

*This research is part of Plant Biological and Molecular Processes, an ARS national program (#302) described at www.nps.ars.usda.gov.*

*Lili Qi is in the USDA-ARS Sunflower and Plant Biology Research Unit, Red River Valley Agricultural Research Center, 1307 18th St. N., Fargo, ND 58102-2765; (701) 239-1351, lili.qi@ars.usda.gov.**

Rust response in three seedling sunflower plants 12 days after inoculation with the most virulent rust race identified so far in the United States. HA 89 (an oil-type sunflower) and CONFSCLB1 (a confection sunflower) are highly susceptible, showing typical symptoms of rust in the infected leaves, whereas HA-R6 (also a confection sunflower) is highly resistant and shows no symptoms.




LILI QI (D3174-1)